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(54) **Ring fixator**

Ringfixateur

Fixateur à anneaux

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- **SCHWARTSMAN V ET AL: "TECHNIQUES OF FRACTURE REDUCTION: THE ILIZAROV METHOD" TECHNIQUES IN ORTHOPAEDICS,US, GAITHERSBURG, MD, vol. 5, no. 4, 1 December 1990 (1990-12-01), pages 53-59, XP000667194**
- **GREEN S A: "COMPONENTS OF THE ILIZAROV SYSTEM" TECHNIQUES IN ORTHOPAEDICS,US, GAITHERSBURG, MD, vol. 5, no. 4, 1 December 1990 (1990-12-01), pages 1-11, XP000667188**

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Description

Field of the Invention

[0001] This invention broadly relates to an external fixator apparatus of the ring type for stabilizing bone fractures.

[0002] The invention provides a ring fixator apparatus of the type specified in the preamble of claim 1 and a tie rod to be incorporated in such a fixator.

[0003] As it is known, there is the necessity to set the mutual position of the rings, depending on the type of treatment to apply or on a particular fracture to stabilize.

Prior Art

[0004] A prior type of known ring fixator apparatuses currently in use comprises rings which are connected with each other by telescoping tie rods adapted to be extended as required. Such fixator apparatuses are of simple construction and are suitable for ready adjustment of the ring spacing, but are useless when the rings need to be mutually set for a greater manoeuvring freedom, e.g. when the inclination of the rings to each other needs to be changed.

[0005] Also available are splint apparatuses wherein the rings are connected by the so-called tie plates, in the form of perforated metal strips. The tie plates afford a wider adjustment of the mutual position of the rings, but are bulky and awkward to manipulate.

[0006] Fixator apparatuses have been proposed wherein the tie rods have their opposite ends connected to the rings through respective hinges, so that a desired mutual positional setting of the rings can be obtained. However, this arrangement results in the construction of a heavy and expensive fixator apparatus.

[0007] PCT application No. WO 97/30650 discloses an external fixator whose two rings are linked to one another by means of triplets of rod sections, wherein the rod sections of each triplet are connected together by two locking joints.

[0008] Another known apparatus is disclosed in Schwartzman V. et al. "Techniques of fracture reduction: the Ilizarov method", Techniques in Orthopaedics, US, Gaithersburg, MD, vol. 5, no. 4, pages 53-59. This apparatus discloses a ring fixator including ties in two sections connected by a joint in the form a buckle that allows to translate or rotate the rings with respect to one another. The preamble of claim 1 is based on this document.

The underlying technical problem of this invention is to contrive a ring fixator apparatus as indicated with such structural and functional features as to fill the demand, at the same time overcoming the shortcomings mentioned hereinabove with reference to the prior art.

Summary of the Invention

[0009] According to the resolution idea at the basis of

the present invention, the setting of the mutual position of the rings is allowed by segmented tie rods.

[0010] Based on this resolutive idea, the invention provides with a fixator apparatus of the ring type as indicated according to claim 1.

[0011] Further features and advantages of a fixator apparatus according to this invention will be apparent in the following description of a preferred embodiment thereof, given by way of non-limitative example with reference to the accompanying drawing figures.

Brief Description of the Drawings

[0012]

- Figure 1 shows a perspective view of a ring fixator apparatus according to the invention.
- Figure 2 shows a perspective view, drawn to an enlarged scale, of a particular joint of the fixator device shown in Figure 1.
- Figure 3 shows a sectional view of the particular joint of Figure 2 taken along line III-III.
- Figures 4, 5 and 6 schematically show perspective views illustrating different settings of the fixator device of Figure 1 in operation.

Detailed Description

[0013] In the drawing views, a fixator device according to the invention is shown overall at 1, and is of the external ring type intended for stabilizing bone fractures.

[0014] In the example, the fixator apparatus 1 is applied to a tibia 2 having a proximal end 3, a distal end 4, and a middle portion 5 broken at 6.

[0015] The fixator 1 comprises a pair of rings, namely a proximal ring 6 and a distal ring 7, and comprises three tie rods 8, 9 and 10 connecting the rings 6 and 7 together.

[0016] The rings 6 and 7 are identical and circular in the example, and have a predetermined diameter. Their axes p-p and d-d, respectively, are coincident in a first condition of operation of the fixator apparatus, that is with the rings 6 and 7 exactly superposed on each other.

[0017] One end 3, 4 of the tibia 2 is secured to each ring 6, 7, respectively, by means of appropriate linking elements, in the form of wires F in the example.

[0018] The tie rods 8, 9 and 10 are identical and essentially extend along parallel directions to the axes p-p and d-d.

[0019] In general, two of the rods 8, 9 and 10, precisely the rods 8 and 9, occupy diametrically opposed positions, while the third rod 10 is positioned at 90°.

[0020] Each of the tie rods 8, 9 and 10 of the fixator apparatus 1 according to the invention is split in two rod sections. In other words, it is split into two rod sections and comprises an upper rod section 11 and a lower rod

section 12 extending along respective axes s-s and i-i. Both rod sections 11 and 12 have the same length and are in the form of a threaded stock.

[0021] The upper rod section 11 has a top end 13 fastened to the upper ring 6 by means of a nut 14 and a locknut 15.

[0022] The lower rod section 12 has a bottom end 16 which is likewise fastened to the lower ring 7 by means of a nut 17 and a locknut 18.

[0023] In each of the rods 8, 9 and 10, the upper section 11 has a bottom end 19, and the lower section 16 has a top end 20. Said ends 19 and 20 are connected to each other by a joint, overall designated at 21, to be described. In Figure 1, the joint of the rod 10 is shown according to a 90° rotation as to the joints of the rods 8 and 9 in order to make visible its other side more conveniently.

[0024] The joint 21 approximately locates at a mid-length of each rod. In particular, the joint 21, which connects the rod section 11 to the rod section 12, overall comprises a pivot mount 22 and a slide mount 23.

[0025] The pivot mount 22 has an axis x-x perpendicular to the axes s-s and i-i of the rod sections 11 and 12, and comprises a sleeve member 24 which is mounted for free rotation about a bush 25 and held snugly in the axial direction between a collar 26 formed integrally with the bush 25 and a snap ring 27 mounted on the bush.

[0026] The rod section 11 has its bottom end 19 engaged threadably in the sleeve member 24 and retained therein by a locknut 28.

[0027] The top end 20 of the lower rod section 12 is engaged in the bush 25 in a manner to be described.

[0028] It should be noted that the pivot mount 22 comprises a locking arrangement 29 for its locking in a predetermined angular position, so that a set angle α is firmly formed between the axes s-s and i-i of the rod sections. In particular, the locking arrangement 29 comprises a slit 30a in the sleeve 24 and a hand-operated clamp screw 30b extended across the slit 30a.

[0029] The slide mount 23 comprises a straight slide way 31 defining a slide axis y-y which is coincident with the pivot axis x-x, and a slider 32 arranged to axially slide along the slide way 31. The slider 32 is realized in the bush 25 which is bored at 33 to fit snugly onto the slideway 31.

[0030] In the example, the bore 33 and the slide way 31 have circular cross-sectional shapes.

[0031] The stroke length of the slider 32 along the slide way 31 is limited by first 34 and second 35 end collars, which are fixed to the slide way 31 at the extremities thereof, and forming travel limiters for the slider.

[0032] The lower rod section 12 is fixed to the end collar 34, with its top end 20 engaged threadably in the collar and retained by a locknut 36.

[0033] Adjustment means 37 is provided for shifting the slider 32 along the slideway 31 and for holding it firmly in a desired predetermined attained position thereon. In particular, the adjustment means 37 comprises an actuating screw 38a which has an axis v-v lying parallel to

the axis y-y at a distance "M" away therefrom, can be manually operated, and is rotatably retained by the collar 34. It further comprises a thread way 38b formed in the collar 26 and engaged in the spin by the actuating screw 38a.

[0034] Thus, an offset "e" can be established between the tie rods within a predetermined range. In particular, the offset is zero, that is the rod axes s-s and i-i are aligned, when the slider 32 is abutting against the collar 34, while it has the maximum offset "emax" (in the example 10mm) when the slider 31 is abutting against the collar 35.

[0035] The actuating screw 38a, being offset by the distance "M" from the axis y-y of the slideway 31, provides a stop against the rotation of the slider 32 around the axis of the slideway 31, and biases the sliding mount 23 of the prismatic type.

[0036] It should be noted that, according to an embodiment of the invention, the sleeve 24 and the bush 25 are made of a material selected among materials transparent to X-radiation, i.e. transparent to X-rays, such as a thermoplastic polyetherterketone resin, known as Peek, with a 30-percent fill of carbon fibers; thus, the whole pivot mount 22 is overall transparent to X-radiation. Similarly the slideway 31 and the slider 32 are made of a transparent material to X-radiation so that, as a result, also the sliding mount 23 is altogether made transparent to X-radiation. Ultimately, the whole joint 21 will therefore be transparent to X-radiation.

[0037] It will be appreciated how, thanks to the above-described structure of the ring fixator apparatus according to the invention, to the proximal ring can be given any desired setting as regards to the distal ring, in base of the type of treatment to be apply or of the specific bone fracture to stabilize, both as regards their spacing and their mutual inclination, or twist, or offset.

[0038] The ring spacing can be readily adjusted by acting on the tie rods themselves, that is on the rod sections 11, 12 formed by threaded stocks, through the nuts and the locknuts 14, 15 and 17, 18 used for fastening them to the rings.

[0039] The mutual ring inclination can be adjusted by acting on the rod 10, specifically on the nuts and locknuts used for fastening a rod section to the ring, while the pivot mounts of the diametrically opposite rods 8 and 9 are easily locked at a corresponding angle α (see Figure 4).

[0040] The twist can be adjusted by acting on the slide mounts 23 of the joints 21 of the three rods 8, 9 and 10 (see Figure 5), which are pre-set to have their sliding directions y-y substantially tangent with the rings.

[0041] Lastly, the offset can be adjusted by acting on the slide mounts 23 of the joints 21 of the three rods 8, 9 and 10 (see Figure 6), which are pre-set with their axes y-y lying all parallel.

[0042] The main advantage of the ring type fixator apparatus according to the invention lies, therefore, in the extremely wide adjustment capacity of mutual settings provided for the rings.

[0043] Another advantage is its uniquely simple structure and its lightweight.

[0044] The adjustments can be easily made without interfering with the operation of X-ray apparatus, on account of the joint being transparent to X-radiation.

[0045] A further advantage is its compact design, i.e. its particularly small overall dimensions, a non-negligible advantage for an external type of fixator device.

[0046] It should be further noted that the invention can be retro-fitted to fixator apparatuses using most of their existing parts, such as the rings, by merely replacing their tie rods.

[0047] In order to fulfil contingent and specific requirements, a skilled person of the field can obviously make many changes and modifications to the above-described fixator apparatus. Such changes and modifications are covered by the protection scope of the invention as defined in the following claims.

Claims

1. An external ring fixator apparatus (1) for stabilizing bone fractures, comprising at least one pair of rings, of which one (6) is proximal and an other (7) is distal, and at least one tie rod (8,9,10) interconnecting the rings to each other, wherein at least one rod (8,9,10) is split into two rod sections (11,12) connected together by a joint (21), **characterized in that** the joint comprises:

- a pivot mount (22) including a sleeve member (24) which is mounted for free rotation about a bush (25) and having a predetermined axis (x-x) for the angular displacement of the rod sections (11,12) and

- a slide mount (23) including a straight slide way (31) and a slider (32) arranged to axially slide along the slide way (31) according to a predetermined sliding direction (y-y) for offsetting the rod sections (11,12).

2. An external ring fixator apparatus according to Claim 1, **characterized in that** it includes an offset adjuster means (37) for shifting the slider (32) along the slide way (31).

3. An external ring fixator apparatus according to Claim 2, **characterized in that** the offset adjuster means (37) comprises an actuating screw (38a) having an axis (v-v) lying parallel to the slide axis (y-y) offset at a defined distance (M) away from the slider (32) for holding the slider (32) firmly in a desired predetermined attained position thereon.

4. An external ring fixator apparatus (1) according to Claim 3, **characterized in that** the bush (25) is integrally made with a collar (26) and that a thread way

(38b) is formed in the collar (26) to be engaged by the actuating screw (38a).

5. An external ring fixator apparatus (1) according to Claim 1, **characterized in that** it comprises first (34) and second (35) end collars, which are fixed to the slide way (31) at the extremities thereof, and forming travel limiters for the slider (32), wherein the actuating screw 38a is rotatably retained by the first collar (34).

6. An external ring fixator apparatus (1) according to Claim 1, **characterized in that** the slider (32) is the bush (25), in such a way that the slide axis (y-y) is coincident with the pivot axis (x-x),

7. An external ring fixator apparatus (1) according to Claim 1, **characterized in that** the axis (x-x) of the pivot mount (22) lies perpendicularly to said rod sections.

8. An external ring fixator apparatus (1) according to Claim 1, **characterized in that** one end (20) of one rod section (12) is fixed to said slide way (31), and one end (16) of the other rod section (11) is fixed to the sleeve member (24).

9. An external ring fixator apparatus (1) according to Claim 1, **characterized in that** said pivot mount (22) comprises locking means (29) for locking the rod sections (11,12) in a predetermined angular position (α).

10. An external ring fixator apparatus (1) according to Claim 9, **characterized in that** the locking means (29) of the pivot mount (22) comprise a slit (30a) formed in the sleeve (24) and a clamp screw (30b) extending across the slit (30a).

11. An external ring fixator apparatus (1) according to Claim 1, **characterized in that** the pivot mount (22) is made of a material transparent to X-radiation.

12. An external ring fixator apparatus (1) according to Claim 1, **characterized in that** the sliding mount (23) is made of a material transparent to X-radiation.

13. A tie rod (8,9,10) for the rings (6,7) of an external ring fixator apparatus (1) for stabilizing bone fractures comprising two rod sections and a joint as specified in any of Claims 1 to 12.

Patentansprüche

1. Externer Ringfixateur (1) zur Stabilisierung von Knochenbrüchen umfassend mindestens ein Paar Ringe, von denen einer (6) proximal und der andere (7)

distal angeordnet ist, und mindestens eine Zugstange (8, 9, 10), die die Ringe miteinander verbindet, wobei die mindestens eine Zugstange (8, 9, 10) in zwei Stangenabschnitte (11, 12) aufgeteilt ist, die über ein Gelenk (21) miteinander verbunden sind, **dadurch gekennzeichnet, dass** das Gelenk eine Schwenkfassung (22) mit einem Hülsenbauteil (24), das zur freien Rotation um eine Büchse (25) angeordnet ist und eine vorbestimmte Achse (x-x) für die winklige Beabstandung der Stangenabschnitte (11, 12) aufweist, und

- eine Gleitfassung (23) mit einem geraden Gleitpfad (31) und einen Gleiter (32), der angeordnet ist, um axial entlang des Gleitpfades (31) gemäß einer vorherbestimmten Gleitrichtung (y-y) zum Versatz der Stangenabschnitte (11, 12) zu geleiten, umfasst.

2. Externer Ringfixateur nach Anspruch 1, **dadurch gekennzeichnet, dass** er Versatzeinstellungsmittel (37) zum Verschieben des Gleiters (32) entlang des Gleitpfades (31) beinhaltet.

3. Externer Ringfixateur nach Anspruch 2, **dadurch gekennzeichnet, dass** das Versatzeinstellungsmittel (37) eine Betätigungsschraube (38a) mit einer Achse (v-v) aufweist, die parallel zu der Gleitachse (y-y) versetzt um einen vorbestimmten Abstand (M) von dem Gleiter (32) liegt, um den Gleiter (32) fest in einer vorherbestimmten gewünschten eingestellten Position darauf zu halten.

4. Externer Ringfixateur (1) nach Anspruch 3, **dadurch gekennzeichnet, dass** die Büchse (25) einstückig mit einem Kragen (26) hergestellt ist und dass ein Gewindegang (38b) in dem Kragen (26) ausgebildet ist, um von der Betätigungsschraube (38a) gekuppelt zu werden.

5. Externer Ringfixateur (1) nach Anspruch 1, **dadurch gekennzeichnet, dass** er erste (34) und zweite (35) Endkragen umfasst, die mit dem Gleitpfad (31) an dessen äußeren Enden verbunden sind und Wegbegrenzer für den Gleiter (32) ausbilden, wobei die Betätigungsschraube (38a) in dem ersten Kragen (34) drehbar gehalten ist.

6. Externer Ringfixateur (1) nach Anspruch 1, **dadurch gekennzeichnet, dass** der Gleiter (32) derart von der Büchse (25) ausgebildet ist, dass die Gleitachse (y-y) mit der Schwenkachse (x-x) zusammenfällt.

7. Externer Ringfixateur (1) nach Anspruch 1, **dadurch gekennzeichnet, dass** die Achse (x-x) der Schwenkfassung (22) rechtwinklig zu den Stangenabschnitten liegt.

8. Externer Ringfixateur (1) nach Anspruch 1, **dadurch gekennzeichnet, dass** ein Ende (20) des einen Stangenabschnittes (12) mit dem Gleitpfad (31) verbunden ist und ein Ende (16) des anderen Stangenabschnittes (11) mit dem Hülsenbauteil (24) verbunden ist.

9. Externer Ringfixateur (1) nach Anspruch 1, **dadurch gekennzeichnet, dass** das Schwenkfassung (22) Verriegelungsmittel (29) zum Verriegeln der Stangenabschnitte (11, 12) in einer vorherbestimmten winkligen Position (α) umfasst.

10. Externer Ringfixateur (1) nach Anspruch 9, **dadurch gekennzeichnet, dass** das Verriegelungsmittel (29) der Schwenkfassung (22) einen Schlitz (30a) umfasst, der in der Hülse (24) ausgebildet ist, und eine Klemmschraube (30b), die sich über den Schlitz (30a) erstreckt.

11. Externer Ringfixateur (1) nach Anspruch 1, **dadurch gekennzeichnet, dass** die Schwenkfassung (22) aus einem für Röntgenstrahlung transparenten Material hergestellt ist.

12. Externer Ringfixateur (1) nach Anspruch 1, **dadurch gekennzeichnet, dass** die Gleitfassung (23) aus einem für Röntgenstrahlung transparenten Material hergestellt ist.

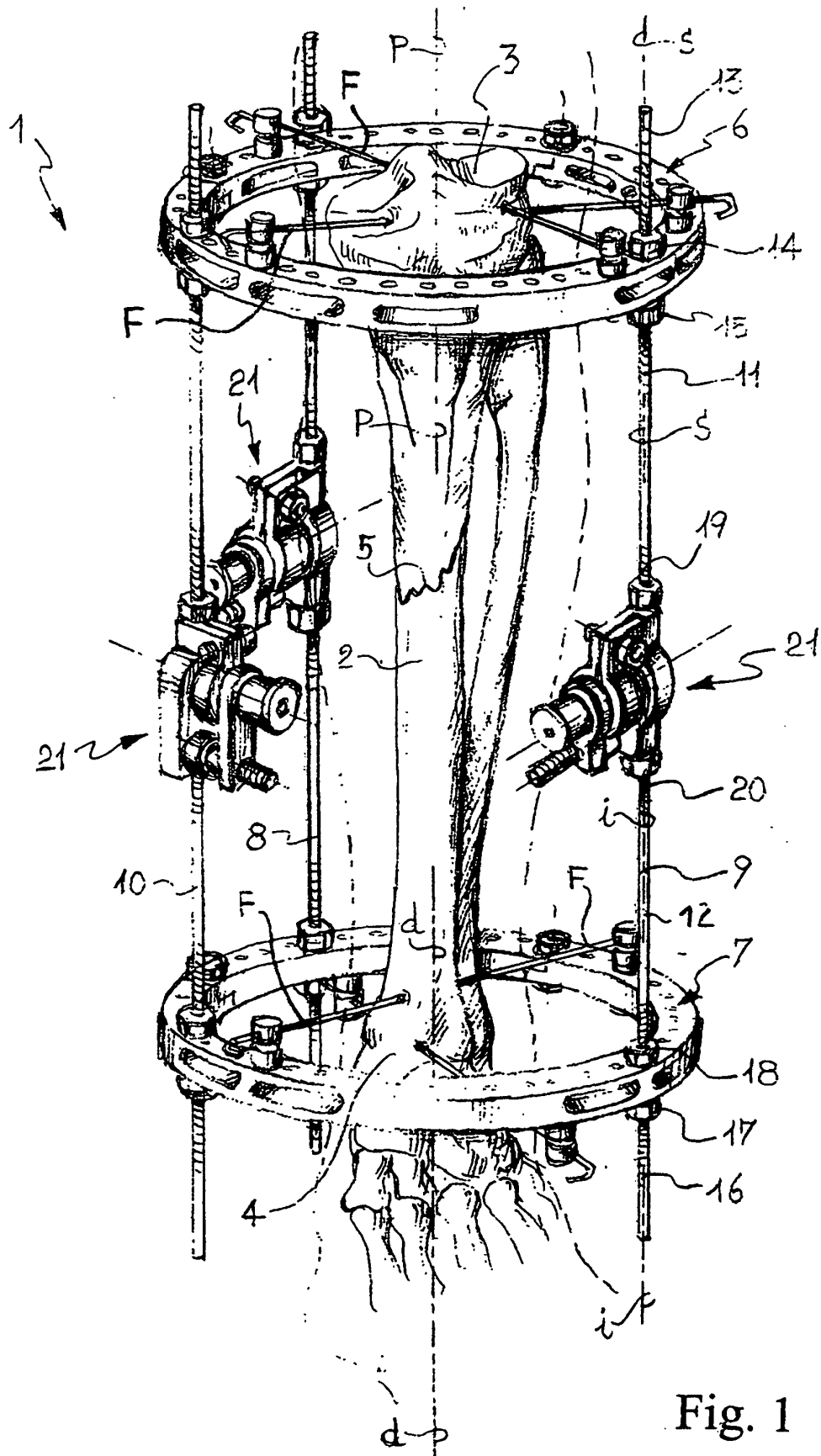
13. Zugstange (8, 9, 10) für die Ringe (6, 7) eines externen Ringfixateurs (1) zum Stabilisieren von Knochenbrüchen umfassend zwei Stangenabschnitte und ein Gelenk, wie in den Ansprüchen 1 bis 12 angegeben.

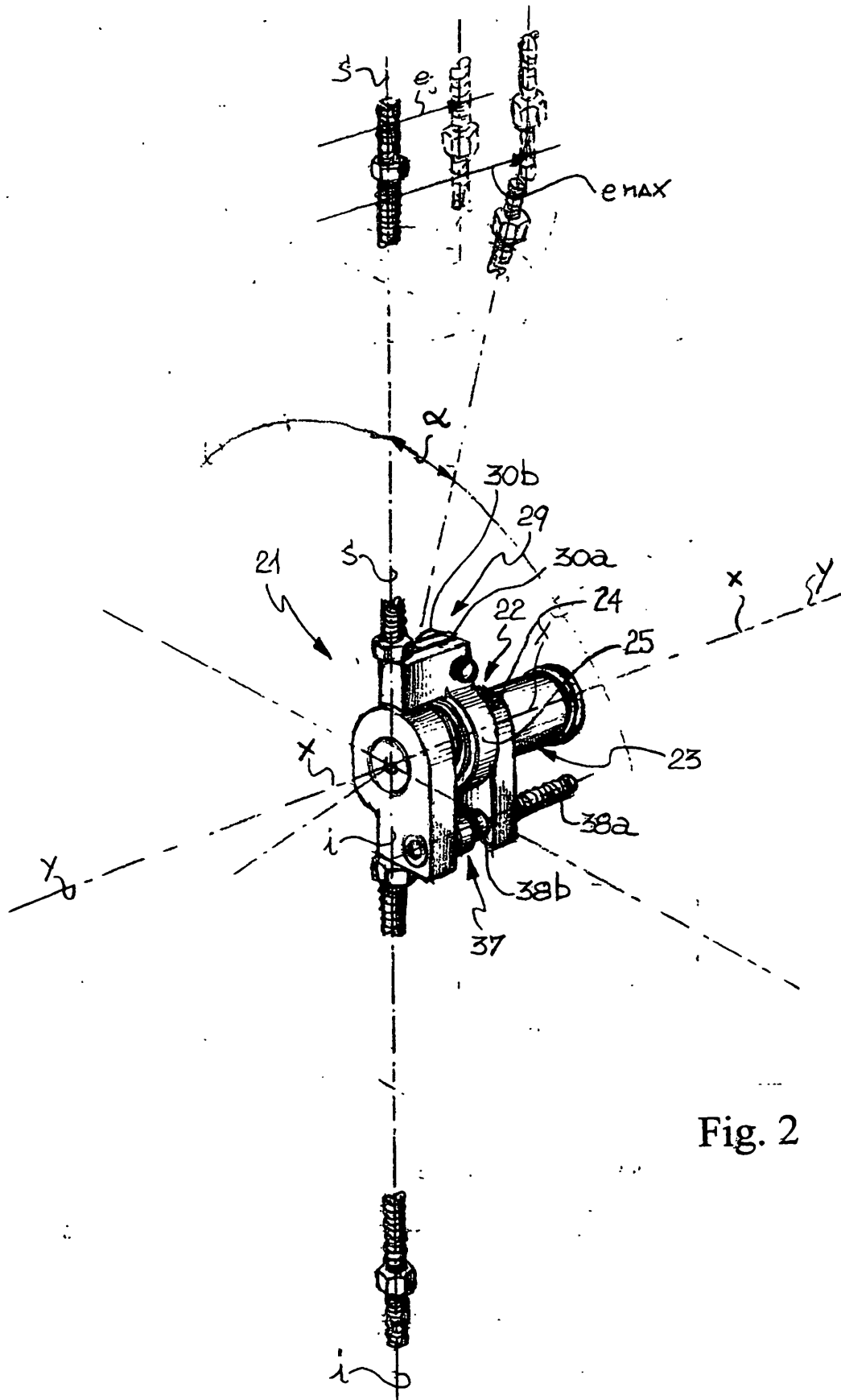
Revendications

1. Appareil (1) de fixation d'un anneau externe pour stabiliser les fractures d'os, comprenant au moins une paire d'anneaux, desquels l'un (6) est proximal et l'autre (7) est distal, et au moins une tige de liaison (8, 9, 10) connectant les anneaux entre eux, dans lequel au moins une tige (8, 9, 10) est divisée en deux sections de tige (11, 12) reliées entre elles par un joint (21), **caractérisé en ce que** le joint comprend :

- un support pivot (22) incorporant un élément de gaine (24) qui est monté libre en rotation au niveau d'une bague (25) et ayant un axe prédéterminé (x-x) pour assurer un déplacement angulaire des sections de tige (11, 12) et
- un support coulissant (23) incorporant une piste (31) de coulissement rectiligne et un coulisseau (32) disposé pour coulisser axialement le long de la piste de coulissement (31) selon une

- direction (y-y) de coulissement prédéterminée pour désaxer les sections de tige (11, 12).
2. Appareil de fixation d'un anneau externe selon la revendication 1, **caractérisé en ce qu'il** comprend un moyen (37) d'ajustement du désaxage pour décaler le coulisseau le long de la piste de coulissement (31). 5
 3. Appareil de fixation d'un anneau externe selon la revendication 2, **caractérisé en ce que** le moyen (37) d'ajustement du désaxage comprend une vis d'actionnement (38a) ayant un axe (v-v) disposé parallèlement à l'axe (y-y) du coulissement décalé à une distance définie (M) éloignée du coulisseau (32) pour maintenir le coulisseau (32) fermement dans une position choisie prédéterminée finale de celle-ci. 10
 4. Appareil (1) de fixation d'un anneau externe selon la revendication 3, **caractérisé en ce que** la bague (25) est réalisée intégralement avec un collier (26) et **en ce qu'une** piste filetée (38b) est réalisée dans le collier (26) pour être engagé par la vis d'actionnement (38a). 20
 5. Appareil (1) de fixation d'un anneau externe selon la revendication 1, **caractérisé en ce qu'il** comprend un premier (34) et un second (35) colliers d'extrémité, qui sont fixés à la piste de coulissement (31) à leurs extrémités et formant des limitations de parcours pour le coulisseau (32), et où la vis d'actionnement (38a) est retenue en rotation par le premier collier (34). 25
 6. Appareil (1) de fixation d'un anneau externe selon la revendication 1, **caractérisé en ce que** le coulisseau (32) est constitué par la bague (25) de telle manière que l'axe de coulissement (y-y) est en coïncidence avec l'axe pivot (x-x). 30
 7. Appareil (1) de fixation d'un anneau externe selon la revendication 1, **caractérisé en ce que** l'axe (x-x) du support pivot (22) est positionné perpendiculairement aux sections de tige. 35
 8. Appareil (1) de fixation d'un anneau externe selon la revendication 1, **caractérisé en ce qu'une** extrémité (20) d'une section de tige (12) est fixée à ladite piste de coulissement (31), et une extrémité (16) de l'autre section de tige (11) est fixée à l'élément de gaine (24). 40
 9. Appareil (1) de fixation d'un anneau externe selon la revendication 1, **caractérisé en ce que** le support pivot (22) comprend un moyen de blocage (29) pour bloquer les sections de tige (11, 12) dans une position angulaire prédéterminée (α). 45
 10. Appareil (1) de fixation d'un anneau externe selon la revendication 9, **caractérisé en ce que** le moyen de blocage (29) du support pivot (22) comprend une fente (30a) réalisée dans la gaine (24) et une vis de clampage (30b) s'étendant à travers la fente (30a). 50
 11. Appareil (1) de fixation d'un anneau externe selon la revendication 1, **caractérisé en ce que** le support pivot (22) est réalisé en un matériau transparent aux rayons X. 55
 12. Appareil (1) de fixation d'un anneau externe selon la revendication 1, **caractérisé en ce que** le support coulissant (23) est réalisé en un matériau transparent aux rayons X.
 13. Tige de liaison (8, 9, 10) pour les anneaux (6, 7) d'un appareil (1) de fixation d'un anneau externe pour stabiliser les fractures d'os comprenant deux sections de tige et un joint comme spécifié dans n'importe quelle revendication 1 à 12.





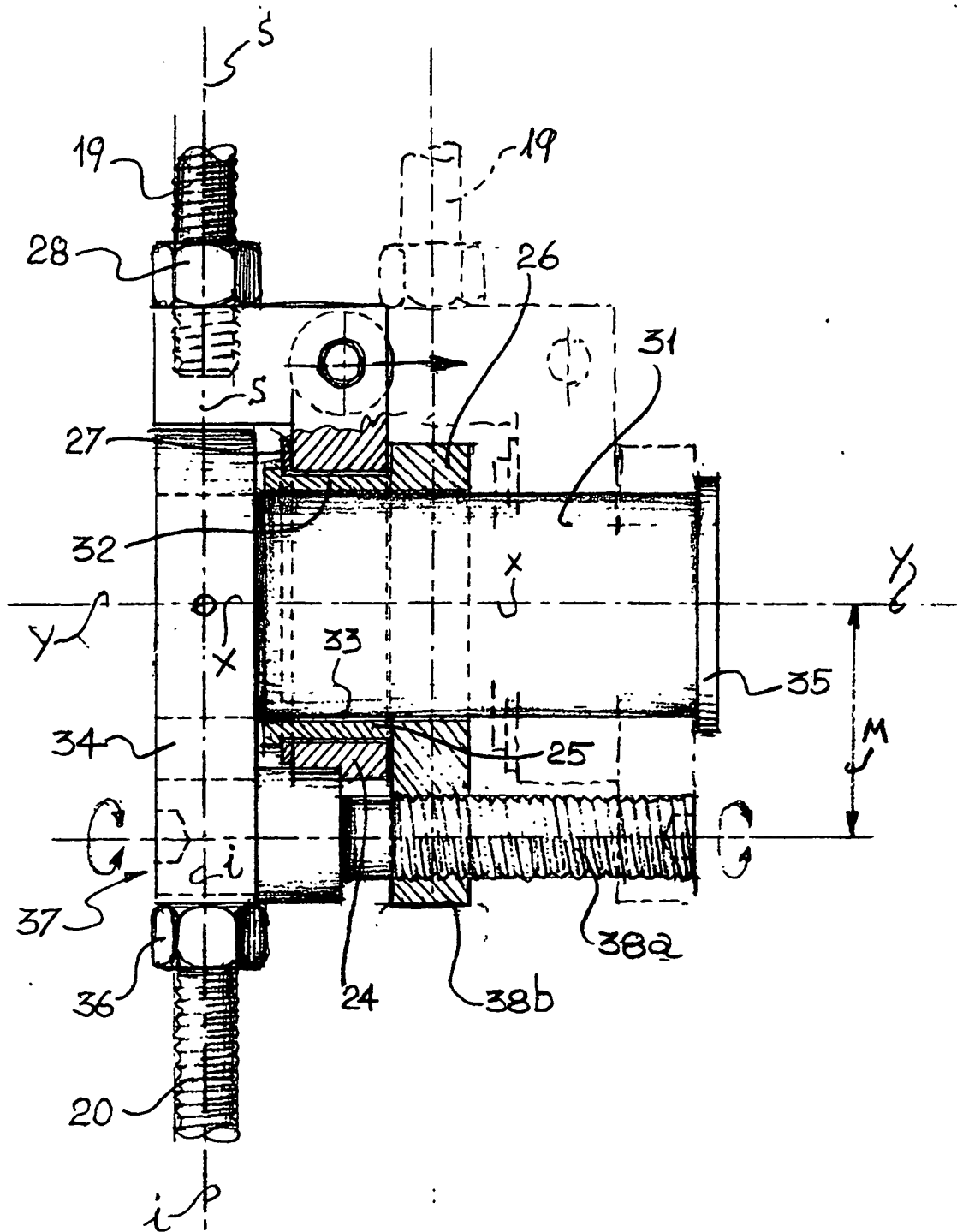


Fig. 3

